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Ikhana UAV

to See First Action this Forest Fire Season

By Rich Tuttle

This year's forest fire season in the United States will see the first use of Ikhana, a new civil version of the high-flying Predator-B unmanned aerial system.

If current plans gel, the season also will see small, unmanned aerial systems move into the zone between demonstrations — which have been successfully conducted in recent years — and true operational capability. Small, low-flying UAS could become truly operational, like fire trucks, in another year or two, well ahead of the large types. The main reason is cost, because small ones are less expensive than big ones.

Small and large UAS might someday operate together over fires, giving officials simultaneous tactical and strategic pictures for thorough understanding of the situation.

Ikhana is news in the large UAS category. NASA bought it last November from General Atomics Aeronautical Systems Inc. for about $9 million, including the ground station and other equipment. The UAS, with a wingspan of 66 feet, was ordered by NASA in April 2005 and is to be delivered to the agency and unveiled to the public this spring. It should be ready to monitor fires in July.

Ikhana — a word in the Choctaw Native American language meaning intelligence, consciousness or awareness — will build on fire surveillance contributions made last fall by General Atomics' Altair, a higher-flying variant of the Predator-B with a wingspan of 86 feet.

Altair flew over the deadly Esperanza fire in California in October, collecting invaluable data and images that helped map the fire's behavior and direct resources to fight it.

Altair was leased by NASA, but owning is better than leasing, says Brent Cobleigh, Ikhana project manager at NASA's Dryden Flight Research Center, Edwards, Calif. For one thing, he says, even though Altair was highly successful, it wasn't as available as NASA would have liked. General Atomics has a number of customers — the U.S. Army, Navy and Air Force and the Department of Homeland Security, for instance — whose missions often trump those of NASA. And because their interest in Altair capabilities is high, NASA was concerned that the big UAS might not be available for its flights. NASA needed a UAS of its own "to get our missions off on time," according to Cobleigh.

NASA will use Ikhana not only for fire missions, which have time sensitivities of their own, but for earth science missions and aeronautics research. These are similar to the fire flights in that they must often be ready to go on short notice.

They "are very dependent on weather patterns and times in the air," Cobleigh says. Dovetailing these demands with a leasing scheme would have been difficult. In addition, NASA plans to make some major modifications of Ikhana, and GA's business is designing and selling airplanes, not doing science experiments, he says.

Finally, he says, NASA's ownership makes it easier to get clearances from the Federal Aviation Administration to fly over forest fires. The FAA is responsible for the safe flight of all aircraft, manned or unmanned, and must approve unmanned operations in advance. Because Altair is owned by GA, the company had to get the FAA's okay to fly in national airspace. But a government agency like NASA "has an easier ability to get clearances to fly unmanned systems than private companies do," Cobleigh says. "There's no question about that," and this was "certainly a player" in NASA's decision to buy Ikhana.

It's a brand new airplane right off the production line, pretty much a basic Predator-B but without weapon systems, Cobleigh says. It is the first of the type, however, to have a digital electronic engine controller (DEEC), developed by GA and Honeywell. This will allow a 5 to 10 percent improvement in fuel efficiency, depending on altitude and airspeed.

This summer, Ikhana will continue a series of platform and sensor demonstrations flown in 2006 by Altair under the Western states UAS fire imaging initiative of NASA, the U.S. Forest Service and universities.

Last Oct. 27, after Altair had successfully completed a series of preplanned missions under the initiative, NASA got an emergency request to use unmanned aircraft to image and map the Esperanza fire in Southern California. The arson-set blaze, ignited the day before, claimed the lives of five firefighters. Whipped by powerful Santa Ana winds, it spread over 40,000 acres, destroying 34 homes and 20 other structures.

The Altair team was quickly reassembled and the UAS departed General Atomics' Gray Butte airfield near Lancaster, Calif., at 3:47 p.m. on Oct. 28. It flew to NASA airspace over nearby Dryden, where it climbed to mission altitude of 43,000 feet. It entered national airspace en route to the Esperanza fire. It began imaging at about 5:15 p.m., remaining over the fire the rest of that day and into the next morning, sending real-time images via satellite link to a server at NASA's Ames Research Center, Moffett Field, Calif. Fire-mapping teams used the information to fight the fire. Altair landed back at Gray Butte at 7:14 a.m. on Oct. 29, logging 16.5 hours of successful emergency fire support flight time.

To help make sure that FAA's authorizations are in place when unmanned systems are needed this time around, "we're starting the process much earlier," says Vince Ambrosia, principal investigator of the Wildfire Research Applications Partnership (WRAP), a team

NASA's Predator B-based Ikhana UAV.

of NASA and Forest Service researchers that runs the Western UAS demos. The process to attain Certificates of Authorization, or COAs, "is a little more streamlined and FAA is more familiar with what we're up to, so we ought to be pretty much a go for this coming year," says Ambrosia, a California State University, Monterey Bay, senior research scientist who is based at Ames. COAs are being requested for half a dozen big areas in the West where fires might break out.

At the same time, Ikhana itself is being prepared. It will use the pod-mounted payload flown by Altair (the NASA-Ames Autonomous Modular Sensor — Wildfire Scanner), but the pod will be carried on the inboard starboard wing hard-point, rather than on the fuselage centerline. A pylon to hold the pod must be built, tested and qualified for Ikhana. Wiring has to be run from the pod into the airplane, and an extra video camera that looks down at a fire must be installed.

Two NASA pilot trainees completed ground school around the first of the year and started flying Ikhana at Gray Butte shortly thereafter. Fire missions will be flown from Dryden. If missions go for 24 hours or so, NASA can activate a contract with General Atomics to bring in additional pilots.

Ikhana's ground control station is in a mobile trailer "so we can fly the whole system, including the airplane, to remote areas," Cobleigh says. "If we had a science experiment in Argentina," for instance, "we would be able to deploy. We're not going to do that for the first year or two, but we're preparing to do that."

NASA's Science Mission Directorate will use Ikhana for atmospheric measurements. Late this year or early next year, it will fly a mission to confirm data gathered by the Aura earth resources satellite. It may also participate in experiments conducted during the International Polar Year, 2008. Ikhana also will be used to develop technologies, such as see-and-avoid systems, to make unmanned aerial systems more reliable and autonomous and potentially less costly.

In the aeronautics research area, one Ikhana proposal has been approved — evaluation of a fiber optic sensor to help measure the shape of the wing at any point in the flight envelope. Data would be used to help design future manned or unmanned planes with large, flexible wings to make them as light, and therefore as fuel efficient, as possible. To accommodate such kinds of research, NASA has added six engineering work stations to the Ikhana trailer, making it a kind of mini-control room.

"We can adapt that for different science and technology demonstrations," Cobleigh says.

Ikhana could fly about five missions during the fire season, equating to some 100 hours in the air. All its imagery will be delivered in near-real time, or about four minutes after collection.

"It'll all be geo- and terrain-rectified and drape right into a map base so [fire officials will] get real time situational awareness," Ambrosia says.

Everett Hinkley, program leader for the Forest Service's Remote Sensing Applications Center in Salt Lake City, Utah, also is optimistic about Ikhana. He agrees that its ability to loiter at high altitudes for long periods over a fire, especially at night, will help provide a strategic picture.

The ability of small UAS to provide a tactical picture from 500 to 1,000 feet also will be evaluated this summer. Several of the vehicles showed their capabilities in demonstrations in 2005 and 2006, but this time they will do so over real fires. The intent, says Hinkley, is to pre-qualify just a few UAS vendors through an RFP, and then match them with individual fires.

"That way, we'll be able to demonstrate real capabilities, fulfilling real needs on a real fire," Hinkley says. "I think that's the best way to move forward."

And, he says, the lower costs of small UAS means they will catch on more quickly. Ambrosia agrees. "I think it's small ones first" in the next few years, he says, noting that a price tag of $50,000 to $100,000 is within the reach of a number of potential operators.

In fact, the Forest Service may be one of the first domestic agencies, outside of the Department of Homeland Security, to use small UAS on a regular basis. It has a pressing need as well as its own relatively small temporary flight restriction areas, meaning less involvement by the FAA. The Forest Service might not own the small vehicles itself, but instead call in private companies that do own them, much the way it does today with helicopters.

Privately owned, fire-monitoring small unmanned aircraft someday may be joined at the lower altitudes by much bigger unmanned planes capable of dropping large quantities of water or fire retardant, Ambrosia says. These big birds would replace the fleet of aging manned air tankers now in operation.

Today's air tankers mostly are highly modified propeller-driven bombers that saw their last days of military service decades ago. This might be "a pretty good niche" for unmanned aircraft because the number of old bombers ready to take on the job is dwindling, Ambrosia says.

Also, he says, "one of the most dangerous jobs in the Forest Service is air tanker pilot, so you want to take the pilot out of that loop." Fatal air tanker crashes underscore his point. Two of the planes crashed in 2002, a C-130A and a P4Y-2, and one, a P-3B, crashed in 2005. Various blue ribbon panels are studying the idea and there are concept designs for UAS tankers, Ambrosia says. "It's a great idea for a direction that is a very appropriate niche market capability" for unmanned aircraft.

But it may take 10 years or more to get there. The fire fighting community "is a really tough group of people" because they don't always trust new technology, Hinkley says.

"It's in their nature. They know what works and what has worked over time, and they trust the technologies that have proved to be trustworthy. It's really hard to get inside that circle to get acceptance, but we're working very hard at doing that" in the small and large UAS fire monitoring areas.

"We're still at the very infancy" of unmanned aircraft, says Cobleigh, the Ikhana project manager. "One of the issues is when you take the pilot out of the airplane, you're taking the intelligence out of the airplane. Part of the industry's goal, and the government's goal, over the next couple of decades is going to be to try to put the intelligence back in the airplane using autonomous systems."

Rich Tuttle is the former editor of Aerospace Daily and a regular contributor to Unmanned Systems Magazine.